

THE COMMISSIONER OF PATENTS AND TRADEMARKS, Washington, D.C. 20231

Enclosed for filing is the patent application of Inventor:
DANIELE BAGNI and GERARD DE HAAN

For: MOTION-COMPENSATED PREDICTIVE IMAGE ENCODING AND DECODING

ENCLOSED ARE:

- ☒ Appointment of Associates;
- ☐ Information Disclosure Statement, Form PTO-1449 and copies of documents listed therein;
- ☒ Preliminary Amendment;
- ☒ Specification (12 Pages of Specification, Claims, & Abstract);
- ☒ Declaration and Power of Attorney:
(1 Page of a ☐ fully executed ☒ unsigned Declaration);
- ☒ Drawing (2 sheets of ☐ informal ☒ formal sheets);
- ☒ Certified copy of European application Serial No.97402763.3
- ☒ Authorization Pursuant to 37 CFR \$1.136(a)(3)
- ☐ Other: ;
- ☐ Assignment to

FEE COMPUTATION

CLAIMS AS FILED				
FOR	NUMBER FILED	NUMBER EXTRA	RATE	BASIC FEE - \$790.00
Total Claims	9 - 20 =		X \$22 =	
Independent Claims	5 - 3 =	2	X \$82 =	164.00
Multiple Dependent Claims, if any			\$270 =	
TOTAL FILING FEE				= \$ 954.00

Please charge Deposit Account No. 14-1270 in the amount of the total filing fee indicated above, plus any deficiencies. The Commissioner is also hereby authorized to charge any other fees which may be required, except the issue fee, or credit any overpayment to Account No. 14-1270.

☐ Amend the specification by inserting before the first line as a centered heading --Cross Reference to Related Applications--; and insert below that as a new paragraph --This is a continuation-in-part of application Serial No. , filed .--, which is herein incorporated by reference--.

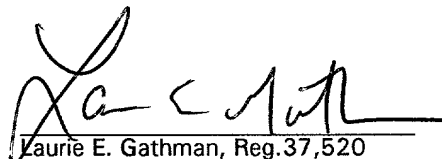
CERTIFICATE OF EXPRESS MAILING

Express Mail Mailing Label No. EM 402 814 967 US
Date of Deposit November 16, 1998
I hereby certify that this paper and/or fee is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 C.F.R. 1.10 on the date indicated above and is addressed to the Commissioner of Patents and Trademarks, Washington, D.C. 20231

Patti DeMichele

Typed Name

Signature



Laurie E. Gathman, Reg.37,520
Attorney
(914) 333-9605
U.S. Philips Corporation
580 White Plains Road
Tarrytown, New York 10591
S:\GA\MC13GAH0.PDO

11/16/98
jc614 U.S. PTO

11/16/98
09/192674
jc518 U.S. PTO

09192674-11698

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of

Atty. Docket

DANIELE BAGNI ET AL

PHN 16,762

Serial No.

Filed: CONCURRENTLY

MOTION-COMPENSATED PREDICTIVE IMAGE ENCODING AND DECODING

Honorable Commissioner of Patents and Trademarks
Washington, D.C. 20231

PRELIMINARY AMENDMENT

Sir:

Prior to calculation of the filing fee and examination,
please amend the above-identified application as follows:

IN THE TITLE

Change the title to all Capitals and delete the period.

IN THE SPECIFICATION

Page 1, before line 1, insert as a centered heading:

--BACKGROUND OF THE INVENTION--;

line 19, insert a centered heading:

--SUMMARY OF THE INVENTION--;

Page 2, line 7, insert as a centered heading:

--BRIEF DESCRIPTION OF THE DRAWINGS--;

line 20, insert as a centered heading:

--DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS--.

IN THE ABSTRACT

Page 12, before line 1, delete in its entirety and substitute

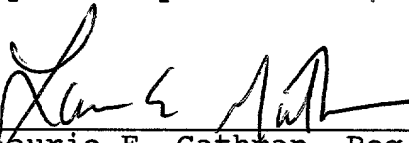
--ABSTRACT OF THE DISCLOSURE--;

last line, delete "(Fig. 3)".

REMARKS

Applicant respectfully requests entry of the foregoing Preliminary Amendment prior to examination of the above-referenced application filed herewith.

Respectfully submitted,

By 
Laurie E. Gathman, Reg. 37,520
Attorney
(914) 333-9605
November 13, 1998

Motion-compensated predictive image encoding and decoding.

The invention relates to motion-compensated predictive image encoding and decoding.

5 As set out in more detail in Sections 1-3 of the first priority application, motion-compensated predictive image encoding and decoding is well known in the art, see References [1]-[4]. A high-quality 3-Dimensional Recursive Search block matching algorithm, also described in the first priority application, is known from References [5]-[7].

As set out in the first priority application, a first motion-compensated predictive
10 image encoding technique (the H.263 standard) is known in which motion vectors are estimated and used for 16*16 macro-blocks. This large macro-block size results in a relatively low number of bits for transmitting the motion data. On the other hand, the motion-compensation is rather coarse. In an extension of the H.263 standard, motion vectors are used and transmitted for smaller 8*8 blocks: more motion data, but a less coarse motion-
15 compensation. However, the higher number of bits required for motion data results in that fewer bits are available for transmitting image data, so that the overall improvement on image quality is less than desired.

20 It is, *inter alia*, an object of the invention to provide improved motion-compensated predictive image encoding and decoding techniques. To this end, a first aspect of the invention provides an image encoding method and device as defined in claims 1 and 3. A second aspect of the invention provides an image decoding method and device as defined in claims 4 and 6. Further aspects of the invention provide a multi-media apparatus (claim
25 7), an image signal display apparatus (claim 8), and an image signal (claim 9). Advantageous embodiments are defined in dependent claims 2 and 5.

In a method of motion-compensated predictive image encoding in accordance with a primary aspect of the present invention, first motion vectors are estimated for first objects, the first motion vectors are filtered to obtain second motion vectors for second

objects, the second objects being smaller than the first objects, prediction errors are generated in dependence on the second motion vectors, and the first motion vectors and the prediction errors are combined.

These and other aspects of the invention will be apparent from and elucidated with reference to the embodiments described hereinafter.

In the drawings:

Fig. 1 shows a basic DPCM/DCT video compression block diagram in accordance with the present invention;

Fig. 2 shows a temporal prediction unit having a motion vector post-filter (MVPF) in accordance with the present invention;

Fig. 3 illustrates block erosion from one vector per 16*16 macro-block to one vector for every 8*8 block;

Fig. 4 shows a decoder block diagram in accordance with the present invention; and

Fig. 5 shows a image signal reception device in accordance with the present invention.

In the image encoder of Fig. 1, an input video signal IV is applied to a frame skipping unit 1. An output of the frame skipping unit 1 is connected to a non-inverting input of a subtracter 3 and to a first input of a change-over switch 7. The output of the frame skipping unit 1 further supplies a current image signal to a temporal prediction unit 5. An inverting input of the subtracter 3 is connected to an output of the temporal prediction unit 5. A second input of the change-over switch 7 is connected to an output of the subtracter 3. An output of the change-over switch 7 is connected to a cascade arrangement of a Discrete Cosine Transformation encoder DCT and a quantizing unit Q. An output of the quantizing unit Q is connected to an input of a variable length encoder VLC, an output of which is connected to a buffer unit BUF that supplies an output bit-stream OB.

The output of the quantizing unit Q is also connected to a cascade arrangement of a de-quantizing unit Q^{-1} and a DCT decoder DCT^{-1} . An output of the DCT decoder DCT^{-1} is coupled to a first input of an adder 9, a second input of which is coupled to the output of the temporal prediction unit 5 thru a switch 11. An output of the adder 9 supplies a

reconstructed previous image to the temporal prediction unit 5. The temporal prediction unit 5 calculates motion vectors MV which are also encoded by the variable length encoder VLC.

The buffer unit BUF supplies a control signal to the quantizing unit Q, and to a coding selection unit 13 which supplies an Intra-frame / Predictive encoding control signal

5 I/P to the switches 7 and 11. If intra-frame encoding is carried out, the switches 7, 11 are in the positions shown in Fig. 1.

In accordance with the present invention, the image encoder of Fig. 1 is characterized by the special construction of the temporal prediction unit 5 which will be described in more detail by means of Fig. 2.

10

As shown in Fig. 2, the temporal prediction unit 5 includes a motion estimator ME and a motion-compensated interpolator MCI which both receive the current image from the frame skipping unit 1 and the reconstructed previous image from the adder 9. In accordance with the present invention, the motion vectors MV calculated by the motion
15 estimator ME are filtered by a motion vector post-filter MVPF before being applied to the motion-compensated interpolator MCI.

In this Section we will describe the real innovative part of our proposal, the motion vector post-filtering (MVPF). Preferably, we want to use the overlapped block motion-compensation based on blocks of size 8*8, as it is actually specified in the Advanced
20 Prediction Mode (APM) of the H.263 standard (described in more detail in the first priority application), in both the encoding and decoding terminals, while transmitting and receiving only macro-block (MB) motion vectors estimated for 16*16 macro-blocks to not increase the bit-rate. This means that both terminals have to use the same MVPF, to re-assign the MB vectors to blocks of 8*8 pixels, as performed in the motion estimation part of APM. Fig. 2
25 shows the temporal prediction unit 5 including the MVPF.

Even if the MVPF should not depend on the estimation strategy, we strongly recommend to use it jointly with the motion estimator described in References [5]-[7], to obtain the best performances. Of course, there are several solutions to calculate the 8*8 block vectors, for example by a weighted averaging of the adjacent 16*16 macro-block
30 vectors, anyway we will describe in detail only what we consider the best solution, due to the inherent features of our new motion estimator, the block erosion MVPF.

As reported in References [1]-[4], in the H.263 standard the motion information is limited to one vector per macro-block of $X*Y = 16*16$ pixels. Therefore, in accordance

with a preferred embodiment, the MVPF performs a block erosion to eliminate fixed block boundaries from the vector field, by re-assigning a new vector to a block of sizes $(X/2)*(Y/2) = 8*8$.

- 5 If $MVc = \vec{d}(\vec{b}_c, t)$ is a macro-block vector centered in \vec{b}_c and its four adjacent macro-block vectors are given by:

$$MVl = \vec{d}(\vec{b}_c - \begin{pmatrix} X \\ 0 \end{pmatrix}, t)$$

$$MVr = \vec{d}(\vec{b}_c - \begin{pmatrix} -X \\ 0 \end{pmatrix}, t)$$

$$MVa = \vec{d}(\vec{b}_c - \begin{pmatrix} 0 \\ Y \end{pmatrix}, t)$$

10 $MVb = \vec{d}(\vec{b}_c - \begin{pmatrix} 0 \\ -Y \end{pmatrix}, t)$

the four 8*8 blocks, numbered as in Fig. 3, will be assigned their new vectors according to the following:

$$MV1 = \text{median}(MVl, MVc, MVa)$$

$$MV2 = \text{median}(MVa, MVc, MVr)$$

15 $MV3 = \text{median}(MVl, MVc, MVb)$

$$MV4 = \text{median}(MVr, MVc, MVb)$$

More specifically, the filtering step MVPF comprises the steps of:

- providing x and y motion vector components of a given macro-block MVc and
 20 of macro-blocks MVl , MVr , MVa , MVb adjacent to the given macro-block MVc ; and
 supplying for each block $MV1$ of a number of blocks $MV1$ - $MV4$ corresponding
 to the given macro-block MVc , x and y motion vector components respectively selected from
 the x and y motion vector components of the given macro-block MVc and from the x and y
 motion vector components of two blocks MVl , MVa adjacent to the block $MV1$.

25

Fig. 3 shows the block erosion of a macro-block vector MVc for a 16*16 macro-block into four block vectors $MV1$, $MV2$, $MV3$, $MV4$ for 8*8 blocks. Block erosion as such for use in a field-rate converter in a television receiver is known from US-A-5,148,269 (Attorneys' docket PHN 13,396). That patent does not suggest that block

erosion can advantageously be used to transmit motion vectors estimated for macro-blocks, while a four times larger number of vectors is used in both the encoder and the decoder to obtain prediction errors for blocks which are four times smaller than the macro-blocks.

5 This solution has not been mentioned in the H.263 standard, but it is fully H.263 compatible. At the start of the multi-media communication the two terminals exchange data about their processing standard and non-standard capabilities (see Reference [4] for more details). If we assume that, during the communication set-up, both terminals declare this MVPF capability, they will easily interface with each other. Hence, the video encoder
10 will transmit only MB vectors for 16*16 macro-blocks, while the video decoder will post-filter them in order to have a different vector for every 8*8 block. In the temporal interpolation process both terminals use the overlapped block motion compensation, as it is specified in the H.263 APM. Thanks to this method, we can achieve the same image quality as if the APM was used, but without increasing the bit-rate.

15 If at least one terminal declares to have not this capability, a flag can be forced in the other terminal to switch it off.

Fig. 4 shows a decoder in accordance with the present invention. An incoming bit-stream is applied to a buffer BUFF having an output which is coupled to an input of a
20 variable length decoder VLC^{-1} . The variable length decoder VLC^{-1} supplies image data to a cascade arrangement of an inverse quantizer Q^{-1} and a DCT decoder DCT^{-1} . An output of the DCT decoder DCT^{-1} is coupled to a first input of an adder 15, an output of which supplies the output signal of the decoder. The variable length decoder VLC^{-1} further supplies motion vectors MV for 16*16 macro-blocks to a motion vector post-filter MVPF to obtain motion
25 vectors for 8*8 blocks. These latter motion vectors are applied to a motion-compensation unit MC which receives the output signal of the decoder. An output signal of the motion-compensation unit MC is applied to a second input of the adder 15 thru a switch 17 which is controlled by an Intra-frame / Predictive encoding control signal I/P from the variable length decoder VLC^{-1} .

30

Fig. 5 shows a image signal reception device in accordance with the present invention. Parts (T, Fig. 4, VSP) of this device may be part of a multi-media apparatus. A satellite dish SD receives a motion-compensated predictively encoded image signal in accordance with the present invention. The received signal is applied to a tuner T, the output

signal of which is applied to the decoder of Fig. 4. The decoded output signal of the decoder of Fig. 4 is subjected to normal video signal processing operations VSP, the result of which is displayed on a display D.

5 It is interesting to note that in one example (described in more detail in the first priority application), the motion vectors (macro-block information) need from 13-18% of the total bit-rate in the basic H.263 standard, and 19-25 % in the H.263 standard with APM and UMV. UMV means Unrestricted Motion Vectors and is described in more detail in the first priority application. Basically, UMV means that the search range is quadrupled from [-16,
10 +15.5] to [-31.5, +31.5].

Thanks to our method, we can use the difference between these amounts of bits for relaxing the DCT coefficients quantization instead of encoding the motion vectors information related to blocks, so that we achieve higher sharpness pictures than actual H.263 standard image encoders with APM, without increasing the bit-rates.

15 On the other hand, if the DCT coefficients quantization is not relaxed, we can encode and transmit "typical H.263 plus APM quality" pictures, while reducing the bit-rate because of no block motion information transmission, thus increasing the channel efficiency.

Finally, in our method every block will be assigned its own motion vectors, while in the APM of H.263 standard not all the macro-blocks will be processed as four
20 separate blocks. In other words, in APM is always possible that there will remain a consistent number of macro-blocks to which a motion vector is assigned, while our method always assigns one proper motion vector to every block.

A primary aspect of the invention can be summarized as follows. The invention
25 relates to a low bit-rate video coding method fully compatible with H.263 standard and comprising a Motion Vector Post-Filtering (MVPF) step. This MVPF step assigns a different motion vector to every block composing a macro-block, starting from the original motion vector of the macro-block itself. In this way the temporal prediction is based on 8*8 pixels blocks instead of 16*16 macro-blocks, as actually is done when the negotiable option called
30 Advanced Prediction Mode (APM) is used in the H.263 encoder. The video decoding terminal has to use the same MVPF step to produce the related block vectors.

Furthermore, since only macro-block vectors are differentially encoded (in a variable length fashion) and transmitted, a considerable bit-rate reduction is also achieved, in comparison with APM.

This method is not yet H.263 standardized, so it has to be signalled between the two terminals, via the H.245 protocol. It can be used at CIF, QCIF and SQCIF resolution.

The following salient features of the invention are noteworthy.

5 A method and an apparatus realizing the method, for H.263 low bit-rate video encoding and decoding stages, which inherently performs the same topics of the so called APM in terms of motion estimation and motion compensation based on 8*8 pixels blocks instead of 16*16 macro-blocks, as actually done only in H.263 encoders and decoders that use the APM.

10 A method and an apparatus realizing the method which further includes a MVPF step placed in the motion estimation stage of the temporal prediction loop of the H.263 video encoder.

 A method and an apparatus realizing the method which further includes a MVPF step placed in the temporal interpolation stage of the H.263 video decoder.

15 A method and an apparatus realizing the method which achieves the same (or even a superior) image quality of the APM, since the temporal prediction is based on 8*8 pixels blocks instead of 16*16 macro-blocks.

20 A method and an apparatus realizing the method which achieves a lower bit-rate in comparison with APM, since only macro-block vectors are differential encoded and transmitted. The image quality is similar to the H.263 standard with APM.

 A method and an apparatus realizing the method which achieves a superior image quality than the H.263 standard with APM, since the bit-budget saved by encoding and transmitting only macro-block vectors is re-used for a less coarse quantization of DCT coefficients. The bit-rates are similar to ones achievable from the H.263 standard with APM.

25 A method and an apparatus realizing the method where the MVPF is a block erosion stage, when the motion estimation is calculated on macro-blocks of H.263 standard dimensions (16*16 pixels). Anyway any other solution can be applied, such as a weighted averaging of adjacent macro-block vectors.

30 It should be noted that the above-mentioned embodiments illustrate rather than limit the invention, and that those skilled in the art will be able to design many alternative embodiments without departing from the scope of the appended claims. In the claims, any reference signs placed between parentheses shall not be construed as limiting the claim. The invention can be implemented by means of hardware comprising several distinct elements,

and by means of a suitably programmed computer. In the device claim enumerating several means, several of these means can be embodied by one and the same item of hardware.

While in a preferred embodiment, 16*16 macro-blocks are reduced to 8*8 blocks, a further reduction to quarter-blocks of size 4*4 is also possible, in which case the predictive encoding

5 is based on the 4*4 quarter-blocks.

References

- [1] ITU-T DRAFT Recommendation H.263, Video coding for low bit rate
10 communication, 2 May 1996.
- [2] K. Rijkse, "ITU standardisation of very low bit rate video coding algorithms",
Signal Processing: Image Communication 7,1995, pp 553-565.
- [3] ITU-T DRAFT Recommendation H.261, Video codec for audio-visual services
at px64 kbits, March 1993.
- 15 [4] ITU-T DRAFT Recommendation H.245, Control protocol for multimedia
communications, 27 November 1995.
- [5] G. de Haan, P.W.A.C. Biezen, H. Huijgen, O. A. Ojo, "True motion
estimation with 3-D recursive search block matching", IEEE Trans. Circuits and Systems for
Video Technology, Vol. 3, October 1993, pp. 368-379.
- 20 [6] G. de Haan, P.W.A.C. Biezen, "Sub-pixel motion estimation with 3-D
recursive search block-matching", Signal Processing: Image Communication 6 (1995), pp.
485-498.
- [7] P. Lippens, B. De Loore, G. de Haan, P. Eeckhout, H. Huijgen, A. Loning,
B. McSweeney, M. Verstraelen, B. Pham, J. Kettenis, "A video signal processor for motion-
25 compensated field-rate up-conversion in consumer television", IEEE Journal of Solid-state
Circuits, Vol. 31, no. 11, November 1996, pp. 1762-1769.

Claims:

1. A method of motion-compensated predictive image encoding, comprising the steps of:

estimating (ME) first motion vectors (MVc, MVl, MVr, MVa, MVb) for first objects (16*16);

5 filtering (MVPF) said first motion vectors (MVc, MVl, MVr, MVa, MVb) to obtain second motion vectors (MV1, MV2, MV3, MV4) for second objects (8*8), said second objects (8*8) being smaller than said first objects (16*16);

generating (3) prediction errors in dependence on said second motion vectors (MV1, MV2, MV3, MV4); and

10 combining (VLC) said first motion vectors (MVc, MVl, MVr, MVa, MVb) and said prediction errors.

2. A method as claimed in claim 1, wherein said first objects (16*16) are macro-blocks, said second objects (8*8) are blocks, and said filtering step (MVPF) comprises the steps of:

15 providing x and y motion vector components of a given macro-block (MVc) and of macro-blocks (MVl, MVr, MVa, MVb) adjacent to said given macro-block (MVc); and

supplying for each block (MV1) of a number of blocks (MV1-MV4)

corresponding to said given macro-block (MVc), x and y motion vector components

20 respectively selected from said x and y motion vector components of said given macro-block (MVc) and from the x and y motion vector components of two blocks (MVl, MVa) adjacent to said block (MV1).

0919294.1169
B69T 426T60

3. A device for motion-compensated predictive image encoding, comprising:
means for estimating (ME) first motion vectors (MVc, MVl, MVr, MVa, MVb)
for first objects (16*16);

means for filtering (MVPF) said first motion vectors (MVc, MVl, MVr, MVa,
5 MVb) to obtain second motion vectors (MV1, MV2, MV3, MV4) for second objects (8*8),
said second objects (8*8) being smaller than said first objects (16*16);

means for generating (3) prediction errors in dependence on said second motion
vectors (MV1, MV2, MV3, MV4); and

means for combining (VLC) said first motion vectors (MVc, MVl, MVr, MVa,
10 MVb) and said prediction errors.

4. A method of motion-compensated predictive decoding, comprising the steps of:
generating (VLC⁻¹) first motion vectors (MVc, MVl, MVr, MVa, MVb) and
prediction errors from an input bit-stream, said first motion vectors (MVc, MVl, MVr,
15 MVa, MVb) relating to first objects (16*16);

filtering (MVPF) said first motion vectors (MVc, MVl, MVr, MVa, MVb) to
obtain second motion vectors (MV1, MV2, MV3, MV4) for second objects (8*8), said
second objects (8*8) being smaller than said first objects (16*16); and

generating (15, MC) an output signal in dependence on said prediction errors
20 and said second motion vectors (MV1, MV2, MV3, MV4).

5. A method as claimed in claim 4, wherein said first objects (16*16) are macro-
blocks, said second objects (8*8) are blocks, and said filtering step (MVPF) comprises the
steps of:

25 providing x and y motion vector components of a given macro-block (MVc) and
of macro-blocks (MVl, MVr, MVa, MVb) adjacent to said given macro-block (MVc); and

supplying for each block (MV1) of a number of blocks (MV1-MV4)
corresponding to said given macro-block (MVc), x and y motion vector components
respectively selected from said x and y motion vector components of said given macro-block
30 (MVc) and from the x and y motion vector components of two blocks (MVl, MVa) adjacent
to said block (MV1).

6. A device for motion-compensated predictive decoding, comprising:
means for generating (VLC^{-1}) first motion vectors (MV_c , MV_l , MV_r , MV_a , MV_b) and prediction errors from an input bit-stream, said first motion vectors (MV_c , MV_l , MV_r , MV_a , MV_b) relating to first objects (16×16);

5 means for filtering (MVPF) said first motion vectors (MV_c , MV_l , MV_r , MV_a , MV_b) to obtain second motion vectors (MV_1 , MV_2 , MV_3 , MV_4) for second objects (8×8), said second objects (8×8) being smaller than said first objects (16×16); and

means for generating (15, MC) an output signal in dependence on said prediction errors and said second motion vectors (MV_1 , MV_2 , MV_3 , MV_4).

10 7. A multi-media apparatus, comprising:
means (T) for receiving a motion-compensated predictively encoded image signal; and
a motion-compensated predictive decoding device as claimed in claim 6 for
15 generating a decoded image signal.

8. An image signal display apparatus, comprising:
means (T) for receiving a motion-compensated predictively encoded image signal;
20 a motion-compensated predictive decoding device as claimed in claim 6 for generating a decoded image signal; and
means (D) for displaying said decoded image signal.

9. A motion-compensated predictively encoded image signal, comprising:
25 motion vectors (MV_c , MV_l , MV_r , MV_a , MV_b) relating to first objects (16×16); and
prediction errors relating to second objects (8×8), said second objects (8×8) being smaller than said first objects (16×16), wherein said prediction errors depend on motion vectors for said second objects (8×8).

Abstract:

In a method of motion-compensated predictive image encoding, first motion vectors (MV_c , MV_l , MV_r , MV_a , MV_b) are estimated for first objects (16×16), the first motion vectors (MV_c , MV_l , MV_r , MV_a , MV_b) are filtered to obtain second motion vectors (MV_1 , MV_2 , MV_3 , MV_4) for second objects (8×8), the second objects (8×8) being smaller
5 than the first objects (16×16), prediction errors are generated in dependence on the second motion vectors (MV_1 , MV_2 , MV_3 , MV_4), and the first motion vectors (MV_c , MV_l , MV_r , MV_a , MV_b) and the prediction errors are combined.

(Fig. 3)

0919264-1169
B69TF 42926T60

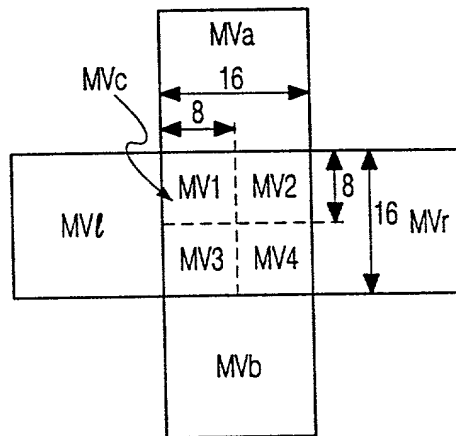


FIG. 3

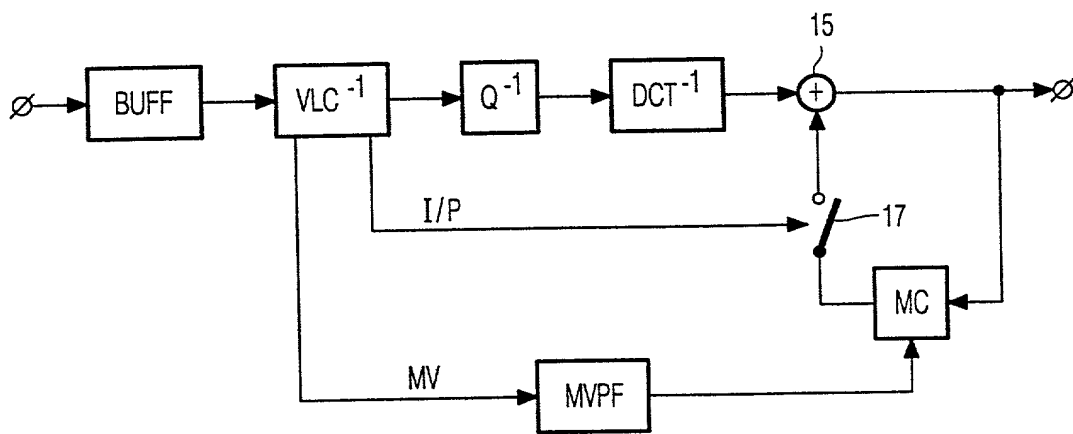


FIG. 4

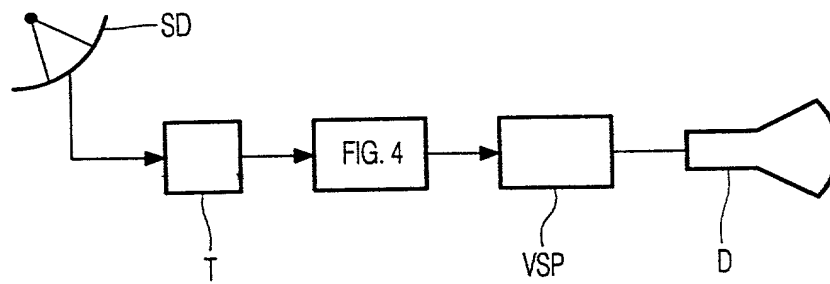


FIG. 5

DECLARATION and POWER OF ATTORNEY

ATTORNEY'S DOCKET NO.:
PHN 16.762

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled **"Motion-compensated predictive image encoding and decoding"**

the specification of which (check one)

☐ is attached hereto.

☐ was filed on _____ as Application Serial No. _____ and was amended on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by the amendment(s) referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, § 119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

PRIOR FOREIGN APPLICATION(S)

COUNTRY	APP.NUMBER	DATE OF FILING (DATE,MONTH, YEAR)	PRIORITY CLAIMED UNDER 35 U.S.C. 119
Europe	97402763.3	17 November 1997	YES
Europe	98200461.6	13 February 1998	YES

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35 United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

PRIOR UNITED STATES APPLICATION(S)

APPLICATION SERIAL NUMBER	FILING DATE	STATUS (PATENTED, PENDING, ABANDONED)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. (list name and registration number)

Algy Tamoshunas, Reg. No. 27,677
Jack E. Haken, Reg. No. 26,902

SEND CORRESPONDENCE TO: Corporate Patent Counsel; U.S. Philips Corporation; 580 White Plains Road; Tarrytown, NY 10591	DIRECT TELEPHONE CALLS TO: (name and telephone No.) (914) 332-0222
--	--

Dated:		Inventor's Signature:		
Full Name of Inventor	Last Name BAGNI	First Name Daniele	Middle Name	
Residence & Citizenship	City Olgiate Molgora	State or Foreign Country Italy	Country of Citizenship France	
Post Office Address	Street Via Promessi Sposi 4	City IT-23887 Olgiate Molgora (Lecco)	State or Country Italy	Zip Code
Dated:		Inventor's Signature:		
Full Name of Inventor	Last Name DE HAAN	First Name Gerard	Middle Name	
Residence & Citizenship	City Eindhoven	State or Foreign Country The Netherlands	Country of Citizenship The Netherlands	
Post Office Address	Street Prof. Holstlaan 6	City 5656 AA Eindhoven	State or Country The Netherlands	Zip Code

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
In re Application of Atty. Docket
DANIELE BAGNI ET AL PHN 16,762

Serial No.

Filed: CONCURRENTLY

MOTION-COMPENSATED PREDICTIVE IMAGE ENCODING AND DECODING
Honorable Commissioner of Patents and Trademarks
Washington, D.C. 20231

APPOINTMENT OF ASSOCIATES

Sir:

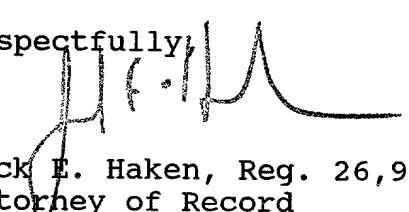
The undersigned Attorney of Record hereby revokes
all prior appointments (if any) of Associate Attorney(s) or
Agent(s) in the above-captioned case and appoints:

Laurie E. Gathman (Registration No. 37,520)

c/o U.S. PHILIPS CORPORATION, Intellectual Property
Department, 580 White Plains Road, Tarrytown, New York
10591, his Associate Attorney(s)/Agent(s) with all the usual
powers to prosecute the above-identified application and any
division or continuation thereof, to make alterations and
amendments therein, and to transact all business in the
Patent and Trademark Office connected therewith.

ALL CORRESPONDENCE CONCERNING THIS APPLICATION AND
THE LETTERS PATENT WHEN GRANTED SHOULD BE ADDRESSED TO THE
UNDERSIGNED ATTORNEY OF RECORD.

Respectfully,


Jack E. Haken, Reg. 26,902
Attorney of Record

Dated at Tarrytown, New York
on November 13, 1998.

S:\GA\APPASOC.GA